

**Product Description Document:
NCEP Model Analyses & Forecasts
03/27/2007**

Part I - Mission Connection

- A. Product Description - Provides meteorological model output graphics on a website maintained by the National Centers for Environmental Prediction (NCEP). This document updates <http://www.weather.gov/infoervicechanges/NCEPMAF.pdf>. This product is described in the <http://www.weather.gov/infoervicechanges/database.pdf> product description database document. The link to model graphics web site is:

<http://www.nco.ncep.noaa.gov/pmb/nwprod/analysis>

There are nine models described in this document:

1. North American Mesoscale (NAM)
2. Global Forecast System (GFS)
3. Wave Watch III (WW3)
4. Nested Grid Model (NGM)
5. Short Range Ensemble Forecast (SREF)
6. Rapid Update Cycle (RUC)
7. High Resolution Window (HRW) Weather Research and Forecast (WRF)
8. Polar Ice Drift (POLAR)
9. Geophysical Fluid Dynamics Laboratory (GFDL) hurricane model

Two models have been added to the Models web site since this document was last published. These are SREF and the GFDL hurricane model.

	03 UTC	09 UTC	15 UTC	21 UTC
SREF	Charts 18-Sep-06	Charts 17-Sep-06	Charts 17-Sep-06	Charts 17-Sep-06

The SREF runs four times a day at 03, 09, 15 and 21 UTC. The SREF graphics are available at 3 hourly increments out to 87 hours for the North American view. The parameters plotted on these graphics include:

1. 250 and 500mb heights and vorticity
2. 250 and 850mb winds and spread
3. 700 and 850mb relative humidity and spread
4. 700 and 850mb temperatures and spread
5. 1000-850, 1000-500, and 850-700mb thickness and spread
6. 10-meter wind and 2-meter temperature
7. Mean sea level pressure
8. Mean CAPE and CIN
9. Lifted index
10. 6-hr precipitation, 12-hr precipitation and 24-hr precipitation
11. Probability of CAPE greater than { 500/2000/3000 depending on season }

12. Probability of 2 meter temperature less than 0 degrees
13. Probability of 10 meter winds greater than 35 knots.
14. 6-hour precipitation greater than 0.25 inches

A basic set of graphics are created for each model on each view for each model forecast time period. In addition to the basic graphics set, graphics for the total accumulated precipitation are added to the North American view. These graphics display total accumulated precipitation for 12 hours, 24 hours, 36 hours, 48 hours, and 60 hours at each model forecast period.

The GFDL hurricane model graphics were added to the North America Models Analyses & Forecasts web page as two links to the Full Domain (Atlantic/Pacific) storms and Nested Domain (5x5 degrees) views as shown in the image below.

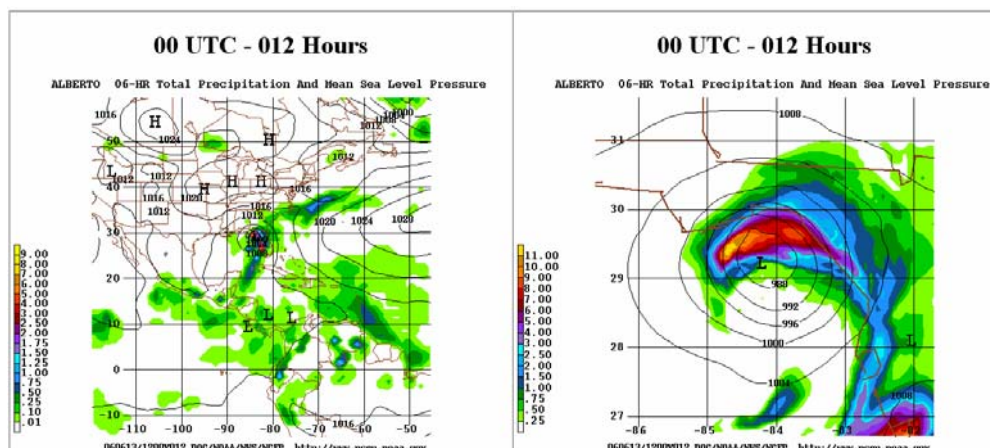
Hurricane Graphics		
HUR	Full Domain	Nested Domain
	24-Oct-06	24-Oct-06

From those pages, two web pages will display up to four hurricanes.

The GFDL hurricane model graphics include seven different types for the Atlantic/Pacific view and seven for the nested “close-up” view for a combined total of 14 graphics. Graphics are available at six hour increments out to 126 hours. These include:

1. 200mb heights, vorticity and winds
2. 500mb streams, relative humidity, and omega
3. 500mb heights, vorticity and winds
4. 700mb heights, vorticity and winds
5. 850mb heights, vorticity and winds
6. 35-meter ground winds, mean sea level pressure, and surface temperature; and
7. 6-hour precipitation and mean sea level pressure.

Shown below is an example of the Atlantic view and the nested “close-up” view for a 6 hour total precipitation forecast.



At least seven graphics are available for each model forecast hour. One each for the Atlantic/Pacific storm and one for the nested view producing fourteen graphics for each GFDL hurricane model forecast hour. The graphics are depicted in different resolutions to accommodate various display and download capabilities. These resolutions are:

1. coarse 640x480 image size, approximately 37 kilobytes per image;
2. medium 1024x768 image size, approximately 70 kilobytes per image;
3. fine 1280x1024 image size, approximately 100 kilobytes per image.

In addition, two series of four panel charts are available. The first of these display a chart at four consecutive forecast time steps up to 126 hours. The second of these are four related graphics at the same forecast hour.

The NAM model graphics include a simulated radar reflectivity graphic created from model output of the 12km version of the NAM model. These graphics cover the entire forecast range of the NAM from 000 hour to 84 hours.

- B. Purpose - The forecast graphics are available on the NCEP website at the same time products from these models are available to National Weather Service and private users. The website is updated as each model forecast hour is completed.
- C. Audience - The major users of the website are the general public as well as governmental organizations, universities, and businesses.
- D. Presentation Format - The data is presented in several standard formats including static images and looping images. The processing that creates these forecast graphics uses the NAWIPS software to convert forecast model output into images to be transferred to the NCEP website. The forecast graphics are available on the NCEP website at the same time products from the models are available to National Weather Service and private users. The NCEP website is updated as each model forecast is completed. The graphics available are similar to those used commonly throughout NCEP.
- E. Feedback Method - We are always seeking to improve our products based on user feedback. A comment form is provided on the meteorological forecast graphics HTML web pages. Comments regarding the products can also be sent to:

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Part II Technical Section

A. Format & Science Basis

Graphics from nine forecast models are available. The forecast models described in this document are: NAM, GFS, WW3, NGM, SREF, RUC, HRW, POLAR, and GFDL hurricane model.

1. North American Mesoscale (NAM)

The North American Mesoscale (NAM) model is a regional mesoscale data assimilation and forecast model system based on the WRF common modeling infrastructure, currently running at 12 km resolution and 60 layers. NAM forecasts are produced every six hours at 00, 06, 12 and 18 UTC. The NAM graphics are available at six hour increments out to 84 hours. The NAM has non-hydrostatic dynamics and a full suite of physical parameterizations and a land surface model. Information on the model products is found at <http://www.nco.ncep.noaa.gov/pmb/products/nam/> page.

The link to the latest information about the NAM model is:

<http://www.emc.ncep.noaa.gov/modelinfo>

2. Global Forecast System (GFS)

The Global Forecast System (GFS) is a global spectral data assimilation and forecast model system. GFS forecasts are produced every six hours at 00, 06, 12 and 18 UTC. The GFS graphics are based on 70 km grid (T190) and are available at six hour increments out to 384 hours. The GFS also produces 35 km (T382) forecast out to 180 hours but these are not converted to graphic images. NCEP implemented major changes to GFS on May 31, 2005. The horizontal resolution increased from approximately 50 km (T254) to approximately 35km (T382) in both the analysis and forecast model. The vertical resolution now 64 layers, with a model top at 0.2 hPa. The GFS contains a full suite of parameterized physics as well as accompanying sea-ice and land-surface models. The model structure is computationally efficient and ready for ESMF (Earth System Modeling Framework) and a hybrid (sigma, p) vertical coordinate. Information on the model products can be found at the production model web page <http://www.nco.ncep.noaa.gov/pmb/products/gfs/>.

The link to the latest information about the GFS is:

<http://www.emc.ncep.noaa.gov/modelinfo>

3. WAVEWATCH III (WW3)

WAVEWATCH III is a third generation wave model developed at NCEP. WW3 forecasts are produced every six hours at 00, 06, 12 and 18 UTC. The WW3 graphics are

based model fields of $1.0^0 \times 1.25^0$ to $5^0 \times 5^0$ and are available at six hour increments out to 126 hours. WAVEWATCH III solves the spectral action density balance equation for wave number-direction spectra. Assumptions for the model equations imply that the model can generally be applied on spatial scales (grid increments) larger than 1 to 10 km, and outside the surf zone. Information on the model products can be found at the production model web page <http://www.nco.ncep.noaa.gov/pmb/products/wave/>.

The link to the latest information about the WW3 is:
<http://www.emc.ncep.noaa.gov/modelinfo>

4. Nested Grid (NGM)

The NGM is a 16-layer primitive equation model with an outer nest covering the Northern Hemisphere at 160 km grid-spacing and an inner nest covering all of North America and offshore waters at 80 km resolution. NGM forecasts are produced every 12 hours at 00 and 12 UTC. The NGM graphics are available at six hour increments out to 48 hours. Its name comes from the technique of using a finer grid over North America and coarser grid over the oceans. It is initialized over North America from the NAM analysis and from a 6 hour GFS forecast for the back half of the hemisphere. While a few gridded products are generated, its output is used primarily to drive a suite of Model Output Statistics (MOS) guidance. Development has been frozen on the NGM since 1990. At the moment, there is no termination date set for this system.

The link to the latest information about the NGM is
<http://www.emc.ncep.noaa.gov/modelinfo>

5. Short Range Ensemble Forecast (SREF)

The Short Range Ensemble Forecast (SREF) system is a set of model runs called ensemble members using either a single model with different initial conditions or different models with the same initial conditions. SREF forecasts are produced every six hours at 03, 09, 15 and 21 UTC. The SREF graphics are available at three hour increments out to 87 hours. The evaluation of SREF has shown improvements in providing CONUS forecasts during the one to three day time range. The SREF runs operationally four times daily. SREF produces ensemble forecasts from 21 members: five ETA members, five ETA Kain-Fristch members, five Regional Spectral Model (RSM) members, and three members each with the WRF-NMM and WRF-ARW. The current SREF aviation ensemble forecast has 11 primary ensemble products, including the probability, mean and spread of: icing, turbulence, cloud, ceiling, visibility, jet stream, lower level wind shear, and tropopause height. Information on the model products can be found at the production model web page
<http://www.nco.ncep.noaa.gov/pmb/products/sref>.

The link to the latest information about the SREF model is
<http://www.emc.ncep.noaa.gov/modelinfo>

6. Rapid Update Cycle (RUC)

The RUC is a hybrid sigma-isentropic analysis and forecast system. It has a horizontal resolution of 13 km and 50 vertical layers. RUC utilizes an hourly data assimilation system. The RUC forecasts are produced every hour. The RUC graphics are available for the most recent 4 hours for forecasts up to 12 hours. Information on the model products can be found at the production model web page <http://www.nco.ncep.noaa.gov/pmb/products/ruc2/>.

The link to the latest information about the RUC model is <http://maps.fsl.noaa.gov/>

7. High Resolution Window (HRW)

The High Resolution Window (HRW) (also known as Nested Window Run or NWR) contains images from the Weather Research and Forecasting (WRF) Model versions of the non-hydrostatic, hybrid vertical coordinate mesoscale model (NMM) and Advanced Research WRF (ARW). WRF forecasts are produced every six hours at 00, 06, 12 and 18 UTC. The WRF graphics are available at three hour increments out to 48 hours. The WRF-NMM replaced Early ETA Forecast Model (ETA) on June 20, 2006. WRF is a next-generation mesoscale numerical weather prediction system designed to serve both operational forecasting and atmospheric research needs. WRF is a multi-agency effort providing the infrastructure that accommodates multiple dynamic solvers, physics packages that plug into the solvers, programs for initialization, multiple dynamical cores, a 3-dimensional variational data assimilation system, and a software architecture allowing for computational parallelism and system extensibility. WRF is suitable for a broad spectrum of applications across scales ranging from meters to thousands of kilometers.

The link to the latest information about the WRF modeling system is: <http://wrf-model.org/index.php>

8. Polar Ice Drift (POLAR)

The Polar and Great Lakes Ice group works on sea ice analysis from satellite, sea ice modeling, and ice-atmosphere-ocean coupling. Automated analyses have been used by the NWS global atmospheric models for their sea ice conditions since February, 1998. POLAR forecasts are produced once daily at 00 UTC. The POLAR graphics are available at 24 hour increments out to 384 hours. The analysis provides a daily, 1/2 degree resolution in latitude and longitude, condition for the models. During spring and fall, the sea ice edge can move by 200 km (2 degrees) in a week. Discussion of the use and representation of sea ice in the global weather models is available at <http://polar.ncep.noaa.gov/seaice/Models.html>.

The link to the latest information about the ice drift system is: <http://polar.ncep.noaa.gov/seaice>

9. Geophysical Fluid Dynamics Laboratory (GFDL) hurricane model

The Geophysical Fluid Dynamics Laboratory provides operational guidance for forecasters at the National Hurricane Center in both the Atlantic and East Pacific basins. Hurricane forecasts are produced on demand every six hours at 00, 06, 12, and 18 UTC for up to four tropical storms at a time. The GFDL hurricane model graphics are available at six hour increments up to 126 hours. Often, there are less than 126 hours.

The model is a nested grid system with an outermost domain and 2 nested grids with resolutions of 55, 27 and 9 km respectively and 42 vertical levels. A spin-up vortex initialization is used with an axisymmetric version of the forecast model forced by intensity and structure parameters provided operationally by NHC. The GFDL hurricane model is coupled to a high-resolution version of the Princeton Ocean Model for the Atlantic Basin and a one dimensional mixed layer model for the East Pacific. The ocean initialization system uses observed altimeter observations to provide a more realistic Loop Current and Gulf Stream conditions. Information on the model products can be found at the production model web page

<http://www.nco.ncep.noaa.gov/pmb/products/hur/>.

The link to the latest information about the GFDL hurricane model is

http://www.gfdl.noaa.gov/research/weather/tpb_gfdl.html

B. Product Availability

This service is provided at the web site www.nco.ncep.noaa.gov/pmb/nwprod/analysis/. The NCEP has no control over the reliability of the Internet. Users need to factor this uncertainty into their decision to use this service.

NCEP does not guarantee the service will be continuously available. However, every effort will be made to assure reliable provision of this service.

C. Additional Information

(1) The Model Analyses & Forecasts web pages are maintained by the NCEP Central Operations Systems Integration Branch. See the link <http://www.nco.ncep.noaa.gov/sib/>

(2) For more information about Models products please contact:

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